

MULTIMEDIA



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STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2018/2019

DET5028 – INDUSTRIAL ELECTRONICS

(Diploma in Electronic Engineering)

27 MAY 2019

2.30 p.m. - 4.30 p.m.

(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 6 pages excluding the cover page with 5 Questions only.
2. Answer **ALL**. All necessary working steps **MUST** be shown.
3. Please write all your answers in the Answer Booklet provided.

Question 1(20 Marks)

(a) An input device, Push Button (PB) is connected to an output device, Cooling Fan (CF) as shown in PLC Ladder Diagram in Figure-1. For each of the following cases, modify the rung of the ladder diagram accordingly.

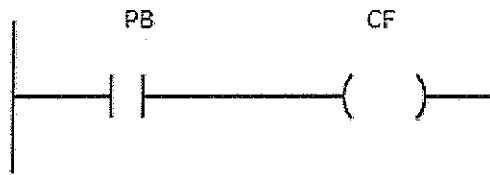


Figure-1

- i. Insert a latching function [2 Marks]
- ii. Insert a STOP Switch (STOP) when CF is latched. [3 Marks]
- iii. Insert an additional input device, Temperature Sensor (TS) such that either PB or TS or both can be used to turn on the CF. [3 Marks]
- iv. Insert an additional output device, Indicator Light (IL) to indicate CF is ON. [2 Marks]

(b) Design a PLC Ladder diagram for the following Specifications:

- i. A counter is used to count the number of times a switch is closed. [2 Marks]
- ii. It is automatically reset when the value of the counter is equal to 5. [2 Marks]
- iii. A Second counter is used to count the number of times the first counter is turned ON. [2 Marks]
- iv. Starting from the 3rd count of the second counter onwards, each press of the switch will turn ON the light. [2 Marks]
- v. The second counter can be manually reset by using a push button. [2 Marks]

Continued ...

Question 2 (20 Marks)

(a) The switching configuration of a DPDT for a bidirectional control of motor is shown in Figure-2. Explain how the DPDT is used to control the direction of the motor.

[6 Marks]

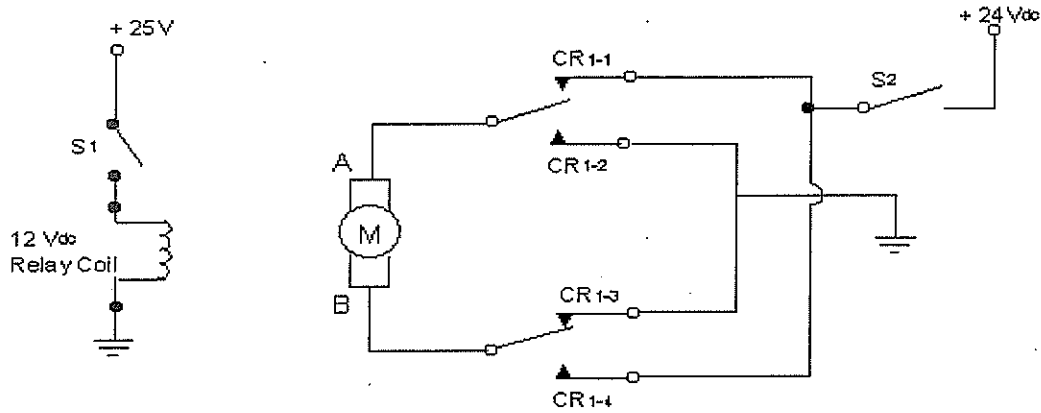


Figure-2

(b) Refer to the relaxation oscillator circuit as shown in Figure- 3. Given that, $V_{dc} = 30V$, $V_{p-n} = 0.7V$, $r_{B2} = 2k\Omega$, $r_{BB} = 8k\Omega$, $V_V = 3V$, $R = 100k\Omega$, $C = 0.10\mu F$, $I_p = 5\mu A$ and $I_V = 4mA$.

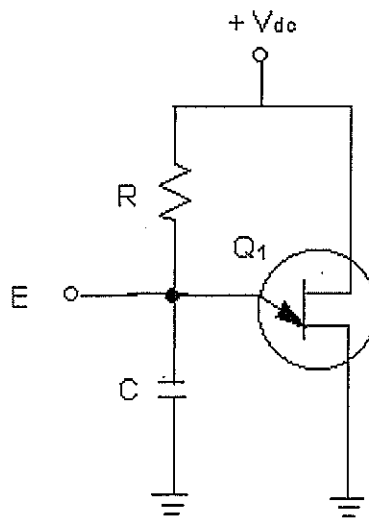


Figure-3

Continued ...

- i. Determine the intrinsic standoff ratio. [3 Marks]
- ii. Calculate V_p . [3 Marks]
- iii. Find the approximate frequency of oscillation. [4 Marks]
- iv. Determine whether R is within the permissible range to ensure firing of the UJT. [4 Marks]

Continued ...

Question 3 (20 Marks)

(a) A platinum RTD has linear temperature coefficient of $0.00392\ ^\circ\text{C}$. The resistance is measured using a bridge circuit with $R_1=250\ \Omega$, $R_2=125\ \Omega$, $R_3=75\ \Omega$ at $20\ ^\circ\text{C}$ as shown in Figure-4. Find the resistance at $60\ ^\circ\text{C}$. [9 Marks]

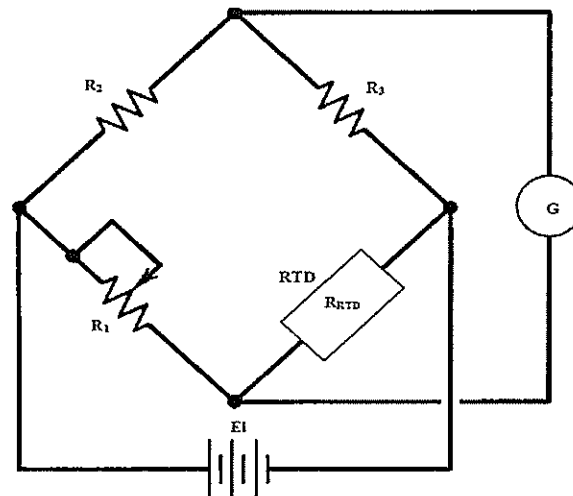


Figure-4

(b)

- i. A strain gauge with an initial resistance R_{old} and a gauge factor (GF) is subjected to a strain ε . Determine the ΔR and R_{new} for the condition $R_{old} = 100\ \Omega$, $GF = 2.02$, $\varepsilon = 1600\ \mu\text{m/m}$. [7 Marks]

- ii. If the indicator wire in the strain gauge having a pretrained length of 20.47mm , calculate the total change in length of the wire and final length after it is strained. [4 Marks]

Continued ...

Question 4 (20 Marks)

(a) A laser diode has a wavelength $\lambda = 2.5\mu\text{m}$ and a differential quantum efficiency $\eta_d = 0.6$. If the output power is $P_o = 5\text{mW}$ and the injection current is 100mA , calculate the threshold current. [7 Marks]

(b) An optical position-encoder has a $10:1$ gear ratio, an optical disc with 40 slits and an 8-bit binary counter.

- i. How much movement of the measured shaft is required to cause the counter to increment by 1 bit? [3 Marks]
- ii. If the measured shaft moves exactly one-half turn (180°) from its prior position, what is the content of the binary counter? [3 Marks]
- iii. What is the maximum allowable shaft motion to ensure that the counter never exceed its capacity? [4 Marks]
- iv. What is the corresponding shaft movement which is represented by a binary output of 1100 0011? [3 Marks]

Continued ...

Question 5 (20 Marks)

(a)

- i. Sketch the equivalent circuit for a shunt-configured DC motor. [3 Marks]

Given that the field winding resistance $R_F = 150 \Omega$ and the applied voltage $V_A = 220V$ in (i)

- ii. Calculate the field current I_F . [2 Marks]
- iii. If a 150Ω -rheostat is inserted into the shunt field circuit, calculate the range of adjustment of I_F . [3 Marks]

(b) Suppose that a shunt- configured DC motor has $K_{EC} = 0.085$, a magnetic field strength $B = 0.84T$, an armature winding resistance $R_A = 2.7 \Omega$, a proportional factor $K_t = 0.81$, an applied voltage of $V_A = 220V$, a field winding resistance $R_f = 145\Omega$ and motor's output torque $\zeta = 3.75Nm$. Determine the motor's mechanical power, P_{mech} and proportionality constant K_{EC} . [12 Marks]

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